even by the ton." Much of the crude material which yields these beautiful and costly products of the continental manufactories is exported from England to be worked up and reimported. The reason of this lies in the more intimate union of science and manufactures which prevails abroad. The chemical manufacturer on the continent finds it to his interest to attach a sound and properly-trained chemist to his works to improve the established methods of production and to seek to discover new processes.

With the space at our disposal it is impossible to do more than merely indicate the scope and character of this series of excellent treatises. There are one or two little matters which need revision, and which the editor will doubtless set right in future editions: for example, the combining proportion of tin is not usually stated as 58, nor that of zinc as 32·6. Perhaps the most serious drawback is the very sparing use of illustrations. When given they are generally very good; nothing could exceed the beauty and finish of the cuts accompanying Mr. Watts' article on cotton. We are sorry that the example thus set has not been more generally followed. T.

HUTTON'S "GEOLOGY OF OTAGO"

Report on the Geology and Gold-fields of Otago. By F. W. Hutton, F.G.S., Provincial Geologist, and G. H. F. Ulrich, F.G.S., &c. (Dunedin: Mills, Dick, and Co.; London: Sampson Low and Co., 1876.)

THE Southern Province of New Zealand is one of great interest from the variety of its physical features which faithfully indicate the wide range of geological formations of which it is built up. The snow-clad ridge of "The Southern Alps," with numerous pointed peaks and serrated ridges, runs along the western coast, and is penetrated by deep "sounds," or fiords, not unlike some of those on the west coast of Norway. Mount Aspiring, at the northern border of the province, reaches an elevation of 9,940 feet, while several other points rise upwards of 8,000 feet above the sea, forming altogether a grand background, from which the rest of the country descends towards the eastern coast in a series of rolling downs, diversified by deep valleys and numerous lakes. The rivers are remarkable for, in several cases, and with much perversity, cutting through ridges, and crossing the boundaries of the formations, in a way that not long ago would have been attributed to the effects of mighty "convulsions of Nature," but which the physical geologist is now able to account for on very different principles. The Southern Alps contain glaciers which, as Mr. Hutton shows very clearly, extended considerably beyond their present bounds on two occasions in later Tertiary times, and to this agency he refers the excavation of the rock basins which now constitute nearly all the lakes of the hilly districts. An excellent view of this chain of snowy mountains will be found in Dr. von Hochstetter's elaborate work on New Zealand; in which Mount Cook, Mount Tasman, and the adjacent mountain giants are seen towering to an elevation of 13,200 feet above the waters of the ocean.

The work before us is a very carefully prepared, and scrupulously accurate, report on the physical features and geological structure of the district of Otago which, under the direction of Dr. Hector, the author has explored and mapped. The arrangement of the matter is good, and the descriptions succinct, while the writer is careful to notice the labours of others in the same field of research. The roughness of some of the woodcut illustrations, which one cannot fail to notice, is perhaps inseparable from a work brought out in a young colony, and is not to be laid to the charge of the author.

As already observed, the geological formations of Otago have a wide range in time, extending from the crystalline masses of the New Zealand Alps (possibly referable to the Laurentian period) through the representatives of the Lower Silurian, Carboniferous, Triassic, Jurassic, Cretaceous, and Tertiary times down to the present day. The thickness of some of these older formations is doubtless very great, but the difficulty which the author feels in estimating the apparent thickness of some of these formations at the amount deduced from the dip of the beds may probably be overcome by supposing that the beds are folded over on themselves—a phenomenon of very common occurrence in such districts as that of the New Zealand Alps. The Otago formations have very properly received names derived from localities where they are well represented. The reference to the equivalent formations in Europe is given with some hesitation; nevertheless, it cannot be doubted that on the whole these determinations are substantially correct—even if we suppose a relative, rather than an absolute, synchronism owing to the vast intervening space between Europe and New Zealand; and for all purposes of comparison it is not of the slightest importance whether it is one or the other.

The great oscillations of level through which New Zealand has passed are well described and illustrated by Mr. Hutton under the head of "Historical Geology." These correspond to some extent with the movements which in Britain and Europe have enabled us to define the limits of the three great divisions of geological time. Towards the close of the Palæozoic period "New Zealand probably formed a subordinate part of a large continent, which, judging by the similarity of the shells and plants, joined in the following formations with those of Australia, India, and Europe, probably stretched far away to the northward" (p. 75).

At the commencement of the Triassic period this continent began in New Zealand to be submerged; and with one or more slight oscillations this subsidence continued till towards the middle of the Jurassic period, when the whole country was again elevated, and the chain of the New Zealand Alps was formed. Great denudation of the upraised beds ensued, as they remained exposed to the atmosphere till the later Cretaceous period. Hence the unconformity between the Upper Cretaceous and the Lower Jurassic rocks (the Warpara and Putataka formations), and the entire absence of the intervening strata. Since the great upheaval here referred to, the New Zealand Alps have never been totally submerged, though sometimes deeply depressed.

The Upper Cretaceous period was one of submergence to all but the higher elevations, and at its close there was another elevation, accompanied by disturbances of the strata, resulting in an unconformity between the Tertiary beds and all those of older date. These former are found

filling in the depressions and old valleys of the Mesozoic and Palæozoic rocks, and often containing valuable beds of lignite resulting from the decay of the vegetation which found a congenial soil and climate amongst the lakes and lagoons of the period.

Mr. Hutton considers that there was a "Glacier period" during older Pliocene times, and another of less importance just before the Pleistocene epoch. Both of these are of earlier date than "The Glacial period" of the northern hemisphere, and in the view of the author, as well as of Dr. von Hochstetter and Dr. Haast,[1] were due not to climatical influences extending over the southern hemisphere and differing from those of the present day, but solely to the greater elevation of the land in New Zealand at those periods, and the consequent extension of snow and ice over a larger area than at present.

In Mr. Hutton, "The Theory of the Glacial Origin of Lakes," at least as far as it applies to the province of Otago, finds a new and welcome advocate; and his observations on this question are opportune at this time, as Prof. Ramsay's theory has been challenged by an able writer in the pages of the *Geological Magazine*.[2] Mr. Hutton first examines the views of those who have referred the origin of these lakes in Otago to subsidences, or terrestrial movements, and considering them inadequate, falls back on that of glacial erosion, in support of which he can appeal to the evidence of former glacial action along the shores of the lakes themselves.

The latter portion of the volume before us is taken up with the report of Mr. Ulrich upon the gold-fields of Otago, which is of much local interest, and will doubtless prove of value in guiding future adventurers, but does not appear to call for special observation in a short review.

OUR BOOK SHELF

Elementary Algebra, with Numerous Exercises, for Use in Higher and Middle-class Schools. By David Munn, F.R.S.E. (Collins' School Series, 1876.)

THE chief justification, perhaps, for the production of this work is that the exigencies of a "school series" demanded the publication of an elementary algebra. There is not much more in it than is to be found in a half-dozen similar works, and the explanations of rules seem to us to fall short of those given elsewhere. We do not like the frequent use of *evidently* in an elementary work; our own extended experience with English schoolboys is that these elementary details are by no means evident to the ordinary schoolboy mind. On p. 70 "the L.C.M. of a^5b^2c and $a^2b^3c^2$ will evidently be $a^3b^3c^3$" is evidently wrong, for it evidently ought to be $a^3b^3c^2$. Art. 8 on p. 45 (to show that when a certain algebraical polynomial is divided by $(x-a)$, the remainder is what the polynomial becomes when in it x is changed to a) is useful, and we teach it to advanced pupils, but we are disposed to think that few beginners could grasp the truth and apply it. On pp. 173 to 176 we have some interesting *Miscellaneous Propositions* on the progressions which we do not remember to have seen in previous text-books. The most important mistakes we have found are on pp. 66, 96, 107, 151, 153. Here we may remark that there is a very plentiful crop of typographical blunders; many of these we are disposed to attribute to a hasty examination of the "proofs;" frequent instances, too, occur in which 2, 3, or 5 have got interchanged. There is a large collection of exercises, but happily no answers are given at the end, or the list of errata would doubtless have been greatly enlarged. From the fact that $(a^m)^n = (a^n)^m$ for positive integers, "it follows that $(a^{\frac{p}{q}})^q = a^p$." This, we think, will hardly be admitted; we should prefer to assume that the result holds, and thence derive an interpretation of $a^{\frac{p}{q}}$. The book takes in Indeterminate Equations, Permutations, Ratio, Proportion, Variation, and the Binomial Theorem. The only Scoticism we have noticed is one that frequently occurs: it is, "we will find," &c.

[1] See Hochstetter's "New Zealand," English translation, p. 504.

[2] No. 139, January 1867. The statements of Mr. Judd have called forth several rejoinders in the ensuing number of the *Magazine* for February.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

The Early History of Magnetism

PERMIT me to supplement "K.'s" excellent sketch of the "History of Magnetism" (NATURE, vol. xiii. p. 523) by two notices of the "Mariner's Compass," which seem to be of earlier date than any hitherto found in Europe. They possess particular interest from showing the compass in so rude a state as to lead to the inference that we owe it to a re-discovery rather than to an importation from China. The author of the notices is Alexander Neckam, an English writer of the twelfth century, and they are now included in a book which was privately printed in 1857, entitled "A Volume of Vocabularies," illustrating the condition and manners of our forefathers from the tenth to the fifteenth century, edited from MSS. in public and private collections, by Thomas Wright, M.A., F.S.A., Hon. M.R.S.L., &c. It was through the zeal and the liberality of Joseph Mayer, F.R.A.S., F.S.A., of Bebington, that these notices were brought to light, and a most useful volume was produced, of which he bore the charge.

As the discovery was made by Mr. Wright, it shall be reported in his own words. In referring to the many points of interest upon which new light is thrown by the vocabularies, he says:—

"None of these, perhaps, is of more importance than the curious early allusion to the use of the mariner's compass by the navigators of the western seas. It is well known to all readers that this invaluable invention has been formerly supposed to have been brought from the East, and not to have been known in the West until the fourteenth century, when it was used by the Italian mariners. Allusions to it have, however, been discovered by the students of mediæval literature in works which date as far back as the thirteenth century. In the following pages we find this invention not only alluded to in the twelfth century, but described in such a manner as to show that it was then absolutely in its infancy, and to leave little doubt of its having originated in the West. Alexander Neckam, in his treatise 'De Utensilibus,' enumerates among the ship's stores a needle which was placed on a pivot, and when turned round and left to take its own position in repose, taught the sailors their way when the polar star was concealed from them by clouds or tempest. I have discovered and printed in the note to this passage, a passage in another of Neckam's works, the inedited treatise 'De Naturis Rerum,' which gives a more distinct account of this invention. 'Mariners at sea,' he says, 'when through cloudy weather in the day which hides the sun, or through the darkness of the night, they lose the knowledge of the quarter of the world to which they are sailing, touch a needle with the magnet, which will turn round till, on its motion ceasing, its point will be directed towards the north.' A comparison of these two passages seems to show pretty clearly that at this time the navigators had no regular box for the compass, but that they merely carried with them a needle which had been touched with the magnet (perhaps sometimes they carried the magnet also, and touched the needle for the occasion), and that when they had to use it they merely placed it upon some point, or pivot, on which it could turn with tolerable freedom, and then gave it a motion, and waited until it ceased moving. This mode of